

CHAPTER 9 CONCLUSIONS AND RECOMMENDATIONS

The goals of the National Multiple Family Submetering and Allocation Billing Program Study were to determine the merits of separate billing programs including the potential water savings, costs and benefits from various perspectives, and the accompanying administrative and regulatory issues. In the study, a retrospective analysis of water use in multi-family properties in 13 cities was conducted. Properties equipped with submeters or that have undergone a billing system conversion were referred to as “impacted properties”. These were identified and compared against the traditional in-rent properties where water and wastewater fees are included as part of the rent. The in-rent group served as the controls. The study compared the two groups using historic billing data provided by participating water utilities combined with information obtained from an extensive series of mail surveys and site visits. The data collected for the study provides a wealth of information about how submetering and allocation affect water use, property owners, and residents. Embedded in these data are insights into this developing industry, including the quantitative aspects of separate billing. The data are also useful for examining the impacts of the 1992 Energy Policy Act (EPACT) plumbing standards and other factors that may influence water use. It is anticipated that the database of submetered and allocated billing program information developed for this study will be a resource for researchers and planners to explore for years to come, particularly if it is maintained and updated.

CONCLUSIONS

Prevalence of Billing for Water and Wastewater at Multi-family Properties

RUBS, submetering, or hybrid metering was reported in 13.4% of the multi-family properties surveyed through the postcard survey. This represents the best estimate from this study of the prevalence of this practice in the multi-family sector. The postcard survey was sent to all of the multi-family properties in the participating study sites’ billing databases. Nationwide the prevalence of separate billing for water and wastewater may be somewhat less because study sites were selected to participate in this study because they were known or thought to have a high concentration of properties receiving water and wastewater bills based on data provided by billing service companies.

Estimated Water Use By Different Billing Methods

One of the central purposes of this study was to determine the water savings associated with submetered and allocation billing programs in multi-family housing. This research question was the over-arching theme for the entire project and a majority of time and effort was spent collecting and analyzing data to provide information on the potential water savings from submetering and RUBS.

Why are water savings so important? Water providers are keenly interested in identifying effective approaches to reducing water demand, as new supplies become increasingly expensive and difficult to obtain. National and state agencies are interested in improving water efficiency and promoting proven methods for achieving savings. The utility billing industry has promoted the practice of charging multi-family customers for water and wastewater services not only as a way to improve property owners' net operating income, but also as a way to effect water conservation. Water savings could provide justification for encouraging, promoting, and expanding billing programs and could unite water providers, regulators, and billing companies in a common goal. As a result there has been intense interest in this question.

Submetering

Submetering achieved statistically significant water savings of 15.3 percent (21.8 gal/day/unit) compared with traditional in-rent properties after correcting for factors such as year of construction (before 1995, 1995 or later), average number of bedrooms per unit, average rent, presence play areas, presence of cooling towers, average price charged for water and wastewater by the local utility, and classification of the property as a retirement community. Not all submetered properties used less water and the statistical model that demonstrated these savings predicted only about 25% of the variability in water use in the observed properties. Statistically significant savings from submetering was found in every single comparison and analysis conducted in this study. Water savings ranged from -5.55 to -17.5 kgal per unit per year, or -15.20 to -47.94 gallons per unit per day (gpd) which is between -10.7% to -25.7%⁴⁰.

⁴⁰ It should be noted that through the site visits, it was found that 3 out of 20 properties visited (15%) had indicated on the manager survey that they were submetered, but were found to only be metering the hot water. Thus, the submetered sample is likely to contain some hot water hybrids.

RUBS

Ratio Utility Billing Systems (RUBS) did not reduce water use by a statistically significant amount compared with traditional in-rent arrangements. The difference between water use in RUBS and in-rent properties was not statistically different from zero. While some RUBS properties used less water on average than in-rent properties, others used the same or more water on average than in-rent properties. Typically the 95 percent confidence interval for RUBS spanned a range that included an increase in expected water use as well as water savings. Statistically significant water use savings from RUBS were detected in only a single comparison test – the matched pair sample. The matched pair comparison relied on the smallest RUBS sample size in the study and, as explained in detail in the body of the report, and the in-rent control sample did not appear to be representative of the population of in-rent properties in the study. After correcting for a wide variety of factors and evaluating numerous different analytic models, the researchers concluded that no statistically significant impact from RUBS could be reliably expected.

Hot Water Hybrid

Hot water hybrid billing systems may achieve water savings, however in this study the sample of hot water hybrid properties was too small to produce reliable results that can be generalized to the broader population. Analysis of data from the limited sample of hot water hybrid properties does suggest that water savings, somewhat smaller than the magnitude found in submetering, *may* be achieved through this billing methodology. This study was unable to verify this finding of savings in a reliable, statistically rigorous manner because of the small sample size. It should be noted that during the site visits it was discovered that 15% of the hot water hybrid properties had been mislabeled by the managers as submetered. This indicates that HWHs may be more common than originally thought, and is suggestive that they may have comparable savings to submetering. However, further research is needed to verify this.

COSTS AND BENEFITS

Beyond quantifying the water savings that can be measured by implementing a multi-family water and wastewater billing program, there are many issues that arise concerning these systems for utilities, for property owners, and for residents. As is true with any developing field,

there are clear benefits to these systems as well as some costs and issues that need to be addressed.

Utility Perspective

Supporting the installation of submeters represents an opportunity for water utilities to capture cost-effective water savings. Savings can be captured in new construction by either requiring the individual metering of multi-family units or by offering incentives in both existing and new multi-family dwellings. Because RUBS has not been found to render reliable savings, it is not cost-effective for utilities to offer incentives promoting RUBS programs. However, since the findings of this report indicate that the savings from fixture upgrades are more substantial than from submetering, utilities should consider offering cost-effective incentives for change-outs for all multi-family properties.

Assuming an annual savings of 7.96 kgal per dwelling unit (du) (21.8 gallons/du/day) from submetering, a utility avoided cost of \$500/AF would translate into a present value savings of \$152 for each dwelling unit that is submetered, assuming a 20 year useful life. The present value of benefits to the utility could be considered a justifiable subsidy that the utility could offer for submetering or other conservation efforts. Obviously, agency avoided cost and assumptions about product life impact the value of submetering for each utility.

Owner Perspective

In most cases, separate billing for water and wastewater will increase the owner's net operating income and property value. Despite the initial capital investment, submetering remains a cost-effective option for owners. In addition, submetering technology has improved so that the cost for submetering new construction and submetering existing properties is reasonable. In the case of allocation, there is no initial investment and the payback is immediate. Owners could use this increase in income to improve overall water efficiency on the property, including fixture upgrades. Nevertheless, before converting to a separate billing system, owners should be aware of the applicable federal, state, and local regulations.

Resident Perspective

Based on the results obtained in the resident survey, consumers have varied opinions on water billing programs. Often these programs result in a water bill in addition to a monthly rent

charge. While consumers receive electric or gas bills, many have come to expect that water charges are included in the rent. As currently practiced, water and wastewater billing programs do not appear to be an appealing option for residents of multi-family dwellings. Also, residents are typically charged a service fee (in conformance with applicable state and local law) in addition to their volumetric or allocated charge. Thus, in the short term, these billing programs cause an increase in monthly costs for residents. While there may be environmental benefits such as increased water conservation, there are many uncertainties involving separate billing that could be perceived as negative. Until separate billing for water and wastewater has some definitive standards and protections for residents, it is unlikely that most residents will embrace it. Direct metering and billing of water for apartment residents encourages water efficiency and promotes a water billing system that is as transparent as other utilities like gas and electricity, phone and cable whereby residents pay for what they use.

If a property owner were to reduce the rent in the approximate amount of the total water and wastewater bill (including the service fee), then the resident might experience no net increase in rental costs if all else is held constant. As noted above, this does not appear to be a common practice. If the property owner were to pay the service fee as recommended (see Recommendation 8, subsection 9), then the overall cost impact to the resident might be reduced. However as practiced today, it appears that water and wastewater billing programs result in increased costs for residents.

ANALYSIS OF PRICE ELASTICITY

Economic goods have a downward sloping demand curve. This means that the higher the price of the good, the less of it that is purchased. Within this broad statement, specific goods respond very differently to price. Some goods respond very little to price change, and others respond a lot. Economists have developed the concept of “price elasticity of demand” to characterize these differences. Price elasticity of demand is defined for each point on the demand curve as: The percentage change in consumption per percentage change in price. Since elasticity is a percent divided by a percent, it is a unitless number.

The elasticity analysis examined the price elasticity of water use based on utility water and wastewater rates. To simplify the analysis, the average non-seasonal (indoor) water use per unit per year in kgal (using 2001 and 2002 billing data) was calculated for each participating

study site. These values were then plotted against the combined utility water and wastewater rate in \$/kgal. The cost for water and wastewater ranged substantially from \$2.83/kgal to \$10.11/kgal, providing a useful data set for analysis. To improve the model fit, the data point from Indianapolis was removed from the elasticity model. Indianapolis was the only study site to feature a declining block rate structure (i.e. the more water used, the cheaper the price). All other utilities had either flat rate or increasing block rate structures designed to send an increasing price signal as demand increases.

Two regression equations and curves were fit to these data to determine the price elasticity of demand – a straight line and a power curve. The fit of both models was quite good and the range of elasticities calculated fits well with previous research in this area. The straight line model had the highest coefficient of determination (r^2) value of 0.6437. Elasticities calculated through the straight line model ranged from -0.12 at \$2.83/kgal to -0.65 at \$10.11/kgal with an average of -0.29 and a median of -0.20. The constant elasticity power curve model had a coefficient of determination value of 0.5477. The elasticity calculated through this power model was -0.275. The research team concluded that if a single elasticity value were to be selected, the preponderance of the results from this analysis point to an elasticity of -0.27. However, the linear model result clearly shows that elasticity varies with price and this should be taken into account when applying these values to planning and rate models.

IMPLICATIONS FOR PUBLIC POLICY

The findings of this report carry broad implications for policy-makers at the local, state, and federal level. In this section, data from the report will be placed in the context of key issues facing the nation's urban water and wastewater managers. Following a discussion of key findings, recommendations are made for appropriate public policies toward separate billing systems.

Separate Billing Systems: Rapid Adoption Without Public Incentives

Billing systems for water and wastewater service - most notably submetering and RUBS systems - are expanding rapidly in the multi-family housing market. Although surveys undertaken for this report found no current examples of public sector incentives for either

submetering or RUBS, and few effective public mandates to submeter, the number of units covered by separate billing systems are reported to have grown by 25% per year during the last four years. This study's postcard survey of multi-family properties in 13 cities found that 13.4% of the responding properties were billing for water by submetering, RUBS, or hybrid methods (see Table 4.3). Based on the postcard survey, traditional in-rent billing for water and wastewater service prevails in about 84.8% of surveyed multi-family units, and that share is dropping. Confirming the trend, the survey of multi-family property managers in the same 13 cities shows evidence that the pace of conversion of existing multi-family dwellings from in-rent to separate billing systems accelerated significantly during the years from 1995 through 1999, and that the pace of conversion activity has remained substantial since that time. Such conversions, coupled with newly constructed units that are operated with water and wastewater billing systems from the start, have made billing services a growth industry.

The business case for property owners' growing interest in separate billing systems is indeed compelling. First, water and wastewater costs have begun to rise more rapidly than either core inflation rates or average rent increases, a trend expected to continue for the foreseeable future. Contributing to the national average, of course, are local water and wastewater rate increases that are markedly, and in some cases, acutely, higher than average increases, such as Washington, DC (42% in 1997), Seattle (24% in 2001), and Buffalo (23% in 2004). Thus, shifting payment for water and wastewater charges from owners to residents insulates property owners from a rapidly rising set of costs.

Secondly, a by-product of this shift in payment for water and wastewater service, from the owners' point of view, is the increased net revenue per unit, and its effect on the capitalized value of the units converted to separate billing methods. There is little published evidence that rents have decreased as water and wastewater charges have been shifted to residents. Rents are determined by broad market forces. A \$25 monthly water bill amounts to less than 3% of a typical \$900 rent payment. What is recognizable, however, is that an increase in net revenue per unit (as a result of redirecting water and wastewater costs to residents) directly influences the capitalized value of the unit, at a ratio of about 10 or 12 to 1 (AWWA WCD 2001). Thus, if separate billing systems increase a property owner's net revenue by \$25 per unit per month, the annual net revenue increase of \$300 per year will increase the value of the unit by \$3,000 to \$3,600. Even if the property owner has no immediate plans to sell, the increased value

immediately strengthens the owner's balance sheet and increases the amount that might be borrowed against the property for improvements or acquisitions elsewhere.

Even without public incentives to spur submetering and without regard to the effects of separate billing on water consumption, elimination of in-rent payment for water and wastewater charges has a strong appeal to property owners. As a result, the trend in conversion to separate billing is likely to continue.

Water Savings Attributable to Submetering are Nationally Significant

One of the key findings of this report is that water savings attributable to submetering and volumetric billing may reach 15% or more. This finding carries important implications for the nation's drinking water and wastewater utilities. Concern for water efficiency is not confined to utilities facing water shortages or periodic droughts. Nationwide, drinking water and wastewater utilities are expected to face capital requirements of some \$274 billion and \$388 billion, respectively, through 2019 (US EPA 2002). According to the US EPA, the gap between necessary investments and current levels of revenue may reach \$102 billion and \$122 billion respectively (US EPA 2002). While not all water and wastewater investments are sensitive to the volume and timing of projected water and wastewater flows, the majority are.⁴¹ The EPA has recognized that reductions in water demand can lead to the deferral or downsizing of water and wastewater capital projects (EPA FY 2005 Budget). Thus, reductions in water consumption by multi-family dwelling residents, if significant, could offer multi-billion dollar cost savings to water and wastewater utilities over time.

The relative significance of water savings in the multi-family housing sector compared with other sectors will vary from utility to utility, depending upon the local housing stock and the types of commercial and industrial activity. At the state and national level, however, these local differences will average out, and the collective savings will be considerable. Nationwide, some 15% of all occupied housing units are configured in multi-family structures of 5 or more units, which are not typically individually metered. The trend in new construction is towards more individual metering. Another 8% of all occupied housing units are contained in structures made

⁴¹For drinking water utilities, capital improvements pertaining to transmission, treatment, storage, and source waters are positively related to water demand, either average demand, peak demand, or both. For wastewater utilities, expenditures for secondary treatment, advanced treatment, interceptor wastewaters, and combined wastewater overflow are positively related to the volume of wastewater flows. These relationships are not linear, but reduced demands will tend to reduce the capital costs of these types of works.

up of 2 to 4 units. The degree to which the units in these smaller buildings - overwhelmingly (84%) rental units - are individually metered or served by a single master meter per structure will again vary considerably by local practice, but undoubtedly a portion of these residents are billed for water through the traditional in-rent method (US Census Bureau 2003).

In recent years, the nation has been adding multi-family housing at an annual rate of about 270,000 units in structures of 5 or more units and another 35,000 units in structures of 2 to 4 units. Taken together, these units comprised about 20% of all housing starts from 1995 through 2002, a still significant share of all new housing (US Census Bureau 2003).

The relative significance of multi-family water savings for the financing of water and wastewater infrastructure becomes even clearer when considering the locational association of multi-family housing with public utilities. While some 16% of the population is not served by a public water system (USGS 2004), nearly all of this self-served population is housed in single-family homes and mobile homes. Conversely, nearly all multi-family housing is served by public water systems. Thus, the relative share of the total housing stock served by public water systems that consists of multi-family housing is in the range of 28%. Similarly, with some 25% of all households not served by a public wastewater system (US EPA 2002), multi-family housing's share of the housing stock served by public wastewater systems is likely to be about 32%.

To gain further perspective on the significance of savings of 15% in the multi-family sector to public water systems, note that public water systems were estimated to withdraw a total of 40,200 million gallons per day (mgd) in 1995, of which 22,700 mgd were for delivery for all "domestic" uses (USGS 1998). For 2000, total withdrawals were estimated to reach 43,300 mgd, an increase of 7.7% (USGS 2004). For the properties surveyed in this report, the 15% savings attributable to submetering and volumetric billing equates to about 21.9 gallons per unit per day. As an upper bound estimate, if all occupied multi-family units throughout the country were to achieve the water use savings documented in this report (15.3%), the total savings would reach nearly 541 mgd, or 1.2% of the total water withdrawals of public water systems across the United States, and about 2.2% of all deliveries for domestic purposes. As efficiency measures go, these savings are significant, and will have multibillion-dollar implications for infrastructure costs over the next twenty years. *Such savings argue strongly for the inclusion of submetering*

among the nation's key strategies for improving water use efficiency and containing water and wastewater infrastructure costs.

RUBS Not Found to Yield Water Savings

Another key finding of this report - the lack of demonstrable and statistically significant savings attributable to RUBS allocation systems - argues that this billing practice need not be encouraged or incentivized for supposed water saving benefits. Indeed, in the absence of demonstrable savings, the downside of RUBS allocation systems requires careful consideration. That RUBS billing practices have been adopted in nearly 10% of multi-family housing units to date is evidence that property owners and managers find it advantageous to shift the cost of water and wastewater service to building residents without assistance or incentive from public agencies.

Efficient Plumbing Yields Savings Under All Billing Formats

This study has also found that the date a multi-family structure was built was a significant factor influencing water use in this 13-city sample of multi-family properties. Specifically, those properties built in 1995 or later were found to use 11 kgal per unit per year less water than properties built in 1994 or prior years. These savings are present in properties, regardless of billing type.

It should be noted that 1994 was the effective date for the manufacture of water-efficient plumbing products meeting the standards contained in the Energy Policy Act of 1992 (EPACT). Since previously manufactured products were allowed to be sold from inventory, 1995 is a useful date for assuming fully compliant plumbing fixtures and fittings in new residential construction. At least 10 states had earlier effective dates for state efficiency standards (NWF 1992), and this factor, together with normal replacements for breakage and remodeling, provides the older age class of buildings with some small fraction of water efficient plumbing. Thus the 11 kgal/unit/year reduction experienced by the post-EPACT class of properties is all the more noteworthy. And while other factors may contribute to reduced water consumption in newer units, such as less degradation of performance in newer products, other studies have affirmed the substantial water savings to be realized by water-efficient plumbing (Mayer et. al. 1999, DeOreo et. al. 2000, 2003, 2004).

These findings strongly suggest that the potential water savings resulting from the installation of water efficient plumbing are as large or larger than the water savings attributable to submetering. For all the reasons cited above regarding water and wastewater infrastructure costs, the expeditious conversion of pre-1995 buildings to EPACT-compliant plumbing fixtures and fittings should be an important policy objective.

Separate Billing Shifts Incentives for Water Efficiency

Water conservation professionals recognize that the relative efficiency of water use across similar end-use categories is influenced by two over-arching factors: behavior⁴² and hardware (Water Resources Engineering 2002a). In an owner-occupied single-family home the homeowner is responsible for both the behavior of water users and the hardware with which water is used. In response to a rising price signal, this sole decision-maker may choose to modify behavior in the short term, or to upgrade hardware over time, or some combination of the two.

In the multi-family rental setting, residents are responsible for in-unit water use habits and behaviors, while decisions regarding hardware repairs and upgrades are the sole purview of the property owner. Under the traditional in-rent billing format for multi-family water and wastewater charges, the property owner is financially exposed to the water consumption behaviors of residents, but exercises complete choice over the water-using fixtures and appliances that are integral to each rental unit. Price-sensitive building owners may seek to offset rising water and wastewater costs with investments in more efficient hardware and more timely repairs of reported leaks.

When multi-family property owners opt for billing systems for water and wastewater charges, a shift in financial exposure takes place. Residents are now financially responsible for their own water-use behaviors and habits. They are individually responsible in a submetered property, and collectively responsible in a property employing RUBS. Residents may modify those behaviors in response to price signals, and this report has documented the savings of submetered residents, while finding little reliable indication that residents take significant action under a RUBS system. But under either billing system, property owners remain responsible for

⁴²Water-use behaviors include not only judgments about how much water to use for routine tasks such as showers, brushing teeth, watering house plants, etc., but also attention to and prompt reporting (to property management) of water leaks in faucets and toilets. Taking action to initiate the maintenance process is clearly an important behavior affecting water consumption.

all repair and replacement decisions regarding fixtures and appliances, even as they are shielded from the price effects of in-unit water consumption. In fact the only cost increases related to in-unit water consumption to which property owners would remain exposed would be the energy cost embedded in hot water in properties where water heating costs are not separately billed to residents. Rising energy prices might encourage a property owner to replace inefficient showerheads with more efficient types, but would offer no incentive for the replacement of in-unit toilets, the largest source of indoor residential water consumption.

The effect of separate billing systems is thus to inject a new degree of price-insensitivity into multi-family residential water use. Water savings resulting from plumbing fixture upgrades - savings that are as large or larger than savings attributable to submetering - may be deferred indefinitely by property owners who will realize no financial benefit from the accelerated replacement of inefficient fixtures. This de-linking of the investment in plumbing upgrades with the financial benefits of reduced consumption is likely to reduce the rate of replacement of plumbing fixtures in pre-1995 multi-family structures, which already lag behind replacement rates for single-family homes (MWDSC and MWDOC 2002).⁴³ State and local policies regarding separate billing systems should take this phenomenon into account.

Best Management Practices for Billing of Water and Wastewater Service

Results from this study, particularly the resident survey component, revealed that many residents in properties with separate utility billing are unsure of how they are being billed for water service. Bills that lack of clarity create confusion and do not send an effective price signal. A substantial number of residents also expressed dissatisfaction with they way they were billed for water and wastewater service. This dissatisfaction has come to the attention of regulators and officials in some jurisdictions (suburban Baltimore, Maryland, Miami-Dade County, Florida, and Texas for example) and has manifested itself in policies where RUBS and in some cases submetering have been discouraged or even prohibited. The practice of discouraging or prohibiting RUBS and possibly submetering may continue unless more decisive action to protect consumers is taken by the billing industry to ensure consumer protection.

⁴³A study in the East Bay MUD service area found total ULFT saturation in 2001 to be slightly higher in multi-family units (37%) vs. single-family units (34%), but the survey universe was not confined to the pre-1995 housing stock (Water Resources Engineering 2002b). Lower levels of free-ridership were detected for multi-family compared with the single-family sector in utility-supported toilet replacement programs (Whitcomb 2002). This is an indication of a lower rate of "natural," i.e., un-incentivized, toilet replacement in multifamily housing.

The National Submetering and Utility Allocation Association (NSUAA) has taken the positive step of developing a set of self-governing “Best Practices Guidelines for Recovering Water and Wastewater Costs in Apartment Properties.” Best practices, or best management practices (BMPs) as they are commonly called, are often issued by trade and professional organizations to establish a code of conduct and to foster self-governance. Best management practices are a reasonable start for dialogue with policy makers and can be used to protect the interests of multi-family dwelling owners, residents, and the public water utilities that serve them.

Consumer Disputes and Appropriate Recourse

Any system of billing consumers can become a venue for disputes. In the survey of multi-family property managers, nearly half of the properties that had converted to separate billing systems reported that there were complaints from residents when the new system was put in place. Indeed, resistance from residents was the lead difficulty encountered by properties that converted to separate billing. About equal numbers of the complaints about conversion asserted that the bills were "too expensive" and that the billing was "unfair".

Of the surveyed residents who said they were dissatisfied with the way they were billed for water, the leading cause was "accuracy of reported consumption" (46%), followed by the "rates" themselves (40%). For dissatisfied RUBS residents, accuracy was a cause of complaint for 55% while rates were of concern to 35%. For dissatisfied submetered residents, 34% were concerned about accuracy, 44% were concerned about rates, and 54% were concerned about service charges on their bill. Relatively few in-rent residents reported being dissatisfied with their billing at all.

One notable finding of the manager survey was the relatively high rate of non-payment of water and wastewater bills by residents. While 50% of the properties reported non-payment rates of 1% or less, some 26% of properties with submetering or RUBS reported non-payment rates of 10% or more. This compares with non-payment rates in the less than 1% to 2% range typically experienced by water utilities themselves. With this level of dysfunction evident in the billing environment, appropriate forms of recourse will be essential to protect the interests of owners and residents alike.

These findings underscore the observation that separate billing for multi-family water and wastewater charges is fundamentally a property owner-resident issue. A degree of consumer protection is provided by existing landlord-tenant law, and where each state and locality chooses to place itself on the spectrum between property owner rights and resident protections is a function of the give and take of the legislative process in each jurisdiction. Water and wastewater billing systems, frequently involving third-party billing service contractors, present distinctive property owner-resident issues that should be accounted for in state and local landlord-tenant law.

RECOMMENDATIONS

Guiding Principles for Submetering and RUBS Billing Programs

In light of the key findings and issues identified in this report, six principles are offered here to guide the development of policies to address separate billing systems for multi-family water and wastewater charges.

1. Submetering is a practice that offers documented water savings. As such, submetering should be fostered by public policies seeking to encourage water savings, together with appropriate measures to protect the consumer.
2. RUBS is a practice lacking statistically reliable water savings, while offering both similar and distinctive drawbacks compared with submetering. As such, RUBS implementation should be carefully bounded by public policy.
3. Any water and wastewater billing system – whether submetering, RUBS, or various hybrid systems – will reduce a multi-family property owner’s incentive to invest in in-unit plumbing efficiency upgrades in pre-1995 structures. The initiation of any separate billing system in pre-1995 dwellings should be coupled with complete plumbing fixture upgrades within a specified time period.
4. The potential drinking water quality issues that may arise within the water systems of multi-family properties – such as backflow, cross-connection, metal uptake, and deterioration of buried distribution lines – should be approached with solutions that address all properties with comparable vulnerabilities, rather than narrowly focusing on properties that implement a water and wastewater billing program.
5. Best Management Practices for the billing of water and wastewater in multi-family housing should be implemented by the appropriate regulatory agency to ensure consumer

protection for property owners and residents and to promote adoption of multi-family submetering.

6. Submetering equipment manufacturers, professional installers, third-party billing services, and owners should be held to reasonable standards of accuracy, reliability, and professional competence and conduct.

Public Policy and Business Practices

A transformation is taking place in the responsibility for water and wastewater service in multi-family properties across the United States. Consistent with the guiding principles outlined above, the researchers offer the following recommendations to increase the likelihood that this transformation advances the public interest while fairly rewarding private investment and initiative.

Policies for Water and Wastewater Utilities

Water and wastewater utilities should implement the following measures to encourage submetering and to secure the benefits of improved efficiency for their systems.

Recommendation 1 – Require notice. Utilities should require multi-family property owners that seek to implement or convert to any billing system, or which have converted in the past, to notify the utility and/or agency. The utilities should keep permanent records of the properties using any water and/or wastewater billing system. As this report demonstrates, the water savings resulting from submetering can be substantial, and the water savings resulting from plumbing upgrades can be even more substantial. But the value for utilities is greatest if these savings can be recognized, plotted into trends, and incorporated into capital facility planning. If a utility does not know what fraction of its multi-family housing has already converted to separate water and/or wastewater billing methods, it will be hard-pressed to estimate the additional savings potential that remains from additional conversion. The status of separate billing and associated plumbing conversion (as recommended above) should be kept as current as possible.

Recommendation 2 – Apply volumetric billing to all multi-family properties. Ensure that volumetric billing is applicable to all multi-family properties for both water and wastewater charges. Although the prevalence of flat or fixed rate structures (where no portion of the charge

varies with volume of use) for multi-family structures is unknown, it persists for single-family residences in many communities⁴⁴ and may be broadly applicable at least to duplexes, 3-family, and 4-family dwellings in such locations. If multi-family resident billing is to be effective in sending a price signal to consumers in multi-family housing, then a responsive price signal has to be sent by the utility in the first place. Where outdoor use and attendant seasonal variation is large, many communities offer seasonal adjustment factors for wastewater service billed from the water meter and/or exemptions from wastewater charges for submetered outdoor use. Submetering of irrigated landscapes offers an additional opportunity to manage outdoor water use efficiently, and should be encouraged in its own right for large parcels, such as multi-family dwelling complexes.

Recommendation 3 – Promote submetering and fixture retrofit. Encourage submetering through judicious targeting of utility water conservation incentives to multi-family submetering conversions. Utilities with active water conservation programs should consider steps to encourage full and partial capture submetering as well as plumbing fixture replacement in pre-1995 buildings. Since submetering offers substantially more savings than RUBS, utilities should consider directing some or all of their plumbing retrofit incentives in the multi-family sector to properties that choose submetering. Tiered incentives to provide additional benefits for properties electing to submeter is another approach. Fixture retrofit should also be promoted in properties that have already undergone billing conversion. While the design and absolute levels of incentive programs are highly site-specific, utilities should look to their incentive programs as an important tool for tipping the balance toward submetering.

Recommendation 4 – Explore direct billing of multi-family residents in new construction. In the interest of encouraging water efficiency gains, utilities should be open to expanding their role beyond traditional master metering of multi-family properties, particularly in new construction. As automated meter reading technology becomes more widely adopted by utilities themselves, the need for direct access by utility personnel to water meters serving multi-family dwellings becomes far less frequent. New construction allows flexibility for the placement of meters in locations designed to be accessible from, or in close proximity to, public space. Duplexes, 3-family, and 4-family units may be easily plumbed for meters from public

⁴⁴In a survey of 420 California cities and districts in 2000, 86% of those surveyed maintained flat (non-volumetric) charges for wastewater service. Surveys in other states by the same firm found non-volumetric charges at 66% of surveyed utilities in Washington, 46% in Oregon, and 32% in Arizona (Black & Veatch 2000).

space. These and other opportunities will present themselves to utilities willing to take the initiative to improve water efficiency and customer service. It should be noted that some utilities may not be interested or willing to venture into multi-family billing that would add a large number of new customers with a high turnover rate.

Policies for State and Local Governments

State law should clearly establish the legal framework for all forms of multi-family billing systems. In lieu of a patchwork of state agency administrative actions, enactment of statutory language that specifically addresses multi-family billing for water and wastewater service is preferable, and would help ensure consistent policy across all agencies and localities. Similarly, state legislation is preferable to a local ordinance, but local action may well be necessary if state legislation is not forthcoming.

Recommendation 5 – Metering for all new multi-family construction⁴⁵

a. **Low-rise multi-family construction:** All new multi-family structures of one to three stories should provide for the measurement of *all* of the water use in each unit. This may be accomplished either through the installation of total-capture submeters for each unit, the installation of utility service meters for each unit, *or* the installation of multiple submeters affixed at every point of use in each unit. Upon occupancy, water and wastewater charges are to be billed to residents based only upon their water usage recorded by these individual measurement devices.

b. **High-rise multi-family construction:** All new multi-family structures of more than three stories constructed after a date which is four years after the effective date of the low-rise requirement above, should provide for the measurement of the water use in each unit. This may be accomplished either through the installation of total-capture submeters for each unit, multiple submeters affixed at points of use throughout each unit, or metered hot (or cold) water use as the basis for allocating all in-unit water use. The allowance of four additional years should be sufficient to resolve any remaining technical issues posed by high-rise plumbing configurations and meter placement. Upon occupancy, water and wastewater charges are to be billed to residents based only upon their water usage recorded by these individual measurement devices, or through an approved hot/cold water hybrid allocation system.

⁴⁵ Subsidized and low income housing developments will likely need to be exempted from this regulation because of various national, state, and local regulations governing the maximum allowable charges for rent and utilities.

Recommendation 6 – Efficient plumbing fixtures required when implementing a billing program. Owners may institute a billing system or continue an already existing billing system for water and wastewater charges *provided* that prior to the institution of any separate billing program or for an existing program within 12 months of official notification, owners comply with the applicable provision (a or b) below:

a. **Older Properties:** Owners of multi-family structures constructed *before* January 1, 1995 (or one year after the effective date of a state or local statute setting a 1.6 gpf standard for all new toilets, if earlier), must perform a water audit in each unit to ensure, any leaks identified have been repaired, and each toilet, showerhead, and faucet aerator is either newly manufactured and installed within the previous 12 months, or operating at no more than 125% of the flush volume or flow rate, respectively, contained in the Energy Policy Act of 1992.

b. **Newer Properties:** Owners of multi-family structures constructed *after* January 1, 1995 (or one year after the effective date of a state or local statute setting a 1.6 gpf standard for all new toilets, if earlier) must perform a water audit in each unit to ensure, any leaks identified have been repaired, and each toilet, showerhead, and faucet is operating at no more than 125% of the flush volume or flow rate, respectively, contained in the Energy Policy Act of 1992.

Recommendation 7 – Once submeters are installed a RUBS system cannot be used. Formula allocation systems (RUBS) may not be used in buildings where total-capture meters or partial-capture hybrid systems for individual units have been installed even if the submetering billing program has been abandoned. To preserve the potential for water savings and maintain the relative benefit to consumers to more equitably distribute costs, abandonment of submetered systems should be discouraged. Limited allocation and estimated billing may be permitted in submetered properties on a temporary basis when specific meters cannot be read or are being serviced or replaced.

Recommendation 8 – Consumer protection. State or local landlord-tenant law or similar legal framework should address the special concerns arising from multi-family water and wastewater billing systems. The section below contains recommended practices for property owners, billing service companies, and water utilities to ensure that consumers are treated fairly. Any number of these practices could be fashioned into a statutory requirements. The degree to which some or all of these provisions are written into law will be based upon the experience of each jurisdiction.

*Best Management Practices for Billing of Water and Wastewater Service in Multi-Family Housing*⁴⁶

The researchers believe a comprehensive set of best practices in the form of regulated industry standards, would benefit all parties involved, including residents, property owners, water providers, regulators, and the billing service providers themselves. The best management practices (BMPs) should be implemented by the appropriate regulatory oversight agencies. BMP standards could greatly improve resident understanding and satisfaction with third party billing, and reduce customer complaints to regulators.

Based on the research results, the following standards for best management practices for water and wastewater billing practices are recommended. BMPs for the billing service industry and for property owners are essentially the same and apply equally. In many cases, property owners and managers handle their own billing for water and are in fact the billing entity. Regardless of who produces the bill, either the owner/manager or a third party billing service company, it is incumbent upon the owner/manager to ensure the proper implementation of these best management practices. The owner maintains the underlying responsibility for the way the billing program is implemented and managed.

Resident rights related to water billing are closely tied to the BMPs for the water billing industry and provide a set of reasonable expectations for residents receiving water and wastewater bills from largely unregulated billing entities.

These best practices are intended to apply generally to *both* submetering and RUBS billing unless specifically noted.

- 1) Billing entity.** Where permitted by law, water and wastewater utility bills may be issued by a property owner or qualified billing agent. Billing agents shall have appropriate insurance coverage.
- 2) Water cannot be dedicated to public use.** Water and wastewater service will only be provided to residents of the property. Non-residents and the general public will not be served. (In many states, this ensures that the property owner is not deemed to be a public utility).
- 3) Common area and vacant units.** The property owner shall pay for water and wastewater service used in common areas, administrative offices, vacant dwelling units, and other portions of the property not designated as dwelling units. Residents are only

⁴⁶These best practices were adopted from and expand upon the guidelines published by the NSUAA

financially responsible for their own water and wastewater service costs. In RUBS properties, common areas should be separately metered. If not possible, a reasonable estimate of common area usage can be made that is based on the property's specific common area amenities.

4) Water audit and leak repair. Before instituting any separate billing system, the property owner/manager shall conduct a water audit of all units and common areas, testing for leaks, including toilet tank flapper valve leaks, and repair all leaks identified. Upon institution of the separate billing system, the property owner/manager shall commit to a reasonable standard of leak repair in all units, and shall maintain sufficient supplies of materials as may be necessary to ensure that common types of leaks (such as toilet flappers) are promptly repaired. When properly reported, non-emergency leakage at any plumbing fixture or fitting should be repaired within 5 business days. The process for reporting leaks and the owner/manager's commitment to leak repair shall be clearly stated in each resident's bill, and shall also be disclosed as part of the lease agreement.

5) Pass through of water and wastewater costs. Both the commodity and fixed service charges for water and wastewater shall be equivalent to the commodity charges contained in the property owner's bill from the local water and wastewater utility.⁴⁷ Neither the billing entity nor the owner/manager shall inflate the costs of these charges. Utility commodity charges and the billing entity charges shall be clearly stated on every bill provided to residents and such rates and charges shall also be disclosed as part of the rental agreement.

6) Submetering and RUBS methods and notification. Water and wastewater bills to residents shall be calculated on the basis of fair and reasonable methods of cost allocation, including submeter readings or allocation formulas. The measurement or allocation method and/or formula is considered a matter of public record and shall be clearly stated on every bill provided to residents. The water and wastewater billing arrangement shall be fully disclosed to the resident in the rental agreement. When a new billing program is started, owners shall provide residents with at least 60 days notice prior to implementation. Billing can only begin after lease signing/renewal.

7) Billing practices. Water and wastewater bills shall be sent promptly after meter readings are made or after the master-meter bill from the utility is received. This is essential to ensure that the price signal is received in reasonably close proximity to the time of consumption. A reasonable amount of time (minimum of 10 business days) shall be allotted between the residents' receipt of a bill and the date payment is due.

8) Records retention and inspection. The property's master water and wastewater utility bills shall be retained for a period of not less than 24 months, and shall be available for inspection by any resident at reasonable hours and without charge. However, a nominal fee can be charged for any requests to copy bills.

⁴⁷ In most cases, these charges will be based on the local utilities' rate schedules for multifamily housing, often priced by the size of the service connection to the master meter. In the case of duplex, 3-family, and 4-family units, the smaller service connections to these structures may result in their being charged at the same rate as single-family residences.

9) **Fees.** The billing entity may charge reasonable fees. Fees are divided into two categories: (a) *recurring service fees*; and (b) *other fees*. *Recurring service fees* (also called monthly fees, administrative fees, or meter fees) shall be charged to the property owner/property manager, not to the residents. Where not subject to regulation, the owner is in the best position to negotiate favorable service fee charges with the billing company and responsibility for recurring service fees gives the owner an interest in negotiating the best fee. Property owners should pay the meter service fee since it is part of the infrastructure of the building and as such would be like repair and maintenance of any building supplied fixture or appliance. *Other fees* (new account fees, late fees, returned check fees, and other reasonable fees that relate to a specific resident account) shall be paid by the residents.

10) **Complaints and disputes.** A fair method for promptly resolving complaints and billing disputes shall be established by the billing entity that should have parity to the process that exists for the property owner contesting a bill to the local water utility. The billing entity shall be available during normal business hours via a toll free number, printed on every bill, to handle billing questions and complaints.

11) **No shutoff of service.** As stated by law, water and wastewater service cannot be shutoff to residents by the owner or his agents. The rental agreement can provide for a utility deposit or other legal remedy through which unpaid utility bills can be collected.

12) **Information to be included in regular bills.** The bill is the fundamental communication between the billing entity and the resident. As such, bills must be clear, comprehensible, and comprehensive. Billing entity water and wastewater bills shall include:

- (a) Clear statement of the current water and wastewater commodity charges and fees as well as any overdue or pending amounts;
- (b) Billing period covered by the bill;
- (c) Date payment is due;
- (d) Date after which payment is overdue;
- (e) Explanation of the billing method (Submetering, RUBS, hybrid);
- (f) Explanation of how charges are determined for current billing period. For *submetering* this will simply be a beginning and ending meter read, the volume consumed, and the commodity rate per unit volume. For *hybrid metering* this will be a beginning and ending meter read, the (hot or cold water) volume consumed, the calculation for allocating the remaining water volume, and the commodity rate per unit volume. For *RUBS* this should include the total volume of water used at the property (as measured by the utility at the master meter(s)), the deductions for common area, the percent of remaining amount allocated to the

individual unit, the volume allocated to the unit, and the commodity rate per unit volume.

(g) Utility commodity charges and the billing entity commodity charges (to assure equivalence);

(h) Information for reporting leaks;

(i) Toll free or local telephone number for customer complaints and billing disputes, and a brief description of the dispute resolution process.

Policies for the US Environmental Protection Agency

Recommendation 9 – Property owners should not be subject to the full suite of National Primary Drinking Water Regulations. Property owners should not be subject to the full suite of National Primary Drinking Water Regulations, with attendant registration and monitoring requirements, solely by virtue of their action to adopt a billing system for water and wastewater service, whether submetering or RUBS. The implementation of either billing system is unlikely to change the quality of water provided to customers on the property.

During the course of this study, EPA’s interpretation of the requirements of the Safe Drinking Water Act have undergone substantial change on this issue, and the Assistant Administrator’s memorandum to Regional Administrators dated December 16, 2003, goes a long way toward adopting this recommendation. The new guidance was drawn to focus on submetering, due to the potential of submetering to support full-cost pricing and the lack of documented water savings attributable to RUBS. EPA should, however, recognize that the value added to a property owner's balance sheet by instituting a billing system – either RUBS or submetering – creates an opportunity to fund the conversion of long-lasting but inefficient plumbing fixtures and fittings to EPACT compliant plumbing. Plumbing conversion will achieve immediate and significant water use reductions in properties of either billing type.

Recommendation 10 – EPA should promote water efficiency in multi-family housing. As part of its “Sustainable Infrastructure Program,” the EPA Office of Water should devise a road map for the research, demonstration, and deployment of emerging technologies and practices that can make significant breakthroughs in multi-family water use efficiency. Property owners and their trade associations, water and wastewater utilities, state and local governments, tenant associations, landscape contractors, building contractors, and environmental advocates are all potential stakeholders and partners in such an effort. EPA should help accelerate the

transformation of water and wastewater billing practices in multi-family housing through targeted research, technical assistance, model ordinances, voluntary bench-marking, and public recognition. But while this report advances our understanding of the benefits of submetering, the report has also found several other variables that significantly effect the water consumption of multi-family housing. The transfer of utility bill payment to residents is an important foundation upon which to build additional gains in water use efficiency.

Policies for Point of Use Meters

Recommendation 11 – Explore Policies for POU Standards. The current plumbing codes do not adequately address POU meters on a number of issues. Industry consensus standards are needed for application condition accuracy, installation protocols, product labeling, and maintenance. The International Association of Plumbing and Mechanical Officials (IAPMO), the National Institute of Standards and Technology (NIST), and to the American Society for Mechanical Engineers (ASME) must evaluate the recommended changes in the plumbing standards.

Based upon the conclusions drawn from the ad hoc committee discussions the following recommendations are offered as standards for POU meters:

Labeling and Identification: Meters shall have the name of the manufacturer, model and serial number, approved orientation positions, and approved temperature ranges.

Manufacturer: Shall specify installation criteria.

Maintenance: Maintenance requirements for POU meters should be consistent with larger utility meters.

Low Battery Voltage: Data transmission needs to be deterministic in that either the data is transmitted accurately or not at all.

Visible Meter Reads: The meter shall have an encoded non-volatile memory. Metered customers shall have ready access to current reading values.

Accuracy: Changes to the current accuracy standards need to be addressed through applications to the appropriate plumbing organizations.

Installation Standards: Use or cite AWWA M6 Manual as reference and follow manufacturer installation specifications. Create a new IAPMO installation standard for water submeters.

RECOMMENDATIONS FOR FURTHER RESEARCH

This research and modeling effort points to some important areas for further study and suggests areas for improvement in data development and study design. Detailed sets of recommendations are also outlined in the AWWA publication (AWWA WCD 2001). As submetering and RUBS billing programs proliferate throughout the United States it will be important to evaluate the implementation and impact of these programs. Some questions for future research include: Are water savings from submetering reliable over a number of years? Are there any statistically verifiable water savings associated with hybrid metering programs?

There are questions that remain concerning RUBS billing practices. Can statistically significant water savings be achieved through a RUBS program if improvements are made to the information provided to the customer? Another question that was raised during this study was whether or not RUBS billing could induce conservation when the number of units commonly metered was lower, thus causing a less dilute price signal. The majority of RUBS properties in this study were larger than 10 units, with the average RUBS property having 184 units. Another study might aim to look at RUBS properties with less than 10 units.

Point-of-use metering is likely to gain wider acceptance in the coming years as additional products and companies enter the market. These systems offer potential to identify leakage and provide useful information on water use to customers, property managers, and water conservation planners. It will be important to evaluate POU metering programs to determine if they are achieving the desired goals and if the potential benefits of the data they can produce are being realized.

Interested parties such as state regulators, local decision makers, water utilities, property owners, and tenants rights organizations need to be kept informed of changes in the regulatory climate nationwide for submetering and RUBS. It may be worthwhile to establish a central repository for collecting and sharing information on regulation, perhaps with AWWA or another similar organization.

Finally this report has put forward 11 central recommendations along with an extensive set of best management practices for the billing industry. How will these recommendations be implemented? Assuming they are implemented, are they achieving the desired impact? These are important questions for future study.